

User Manual

BC50M – Box PC for In-Vehicle Applications



Configuration example

BC50M - Box PC for In-Vehicle Applications

The BC50M (formerly called BC1) is a maintenance-free box computer that has been designed for independent use or as display computer electronics for use in vehicles, e.g. in trains, commercial vehicles, mobile machines or airplanes.

It is powered by an AMD Embedded G-Series APU (Accelerated Processing Unit), the T48N, running at 1.4 GHz. The G-Series combines low-power CPUs and advanced GPUs, in this case an AMD Radeon™ HD 6310, into a single embedded device. The use of the Embedded G-Series makes for high scalability in CPU (single/dual core) and graphics performance (various Radeon™ GPUs or none at all).

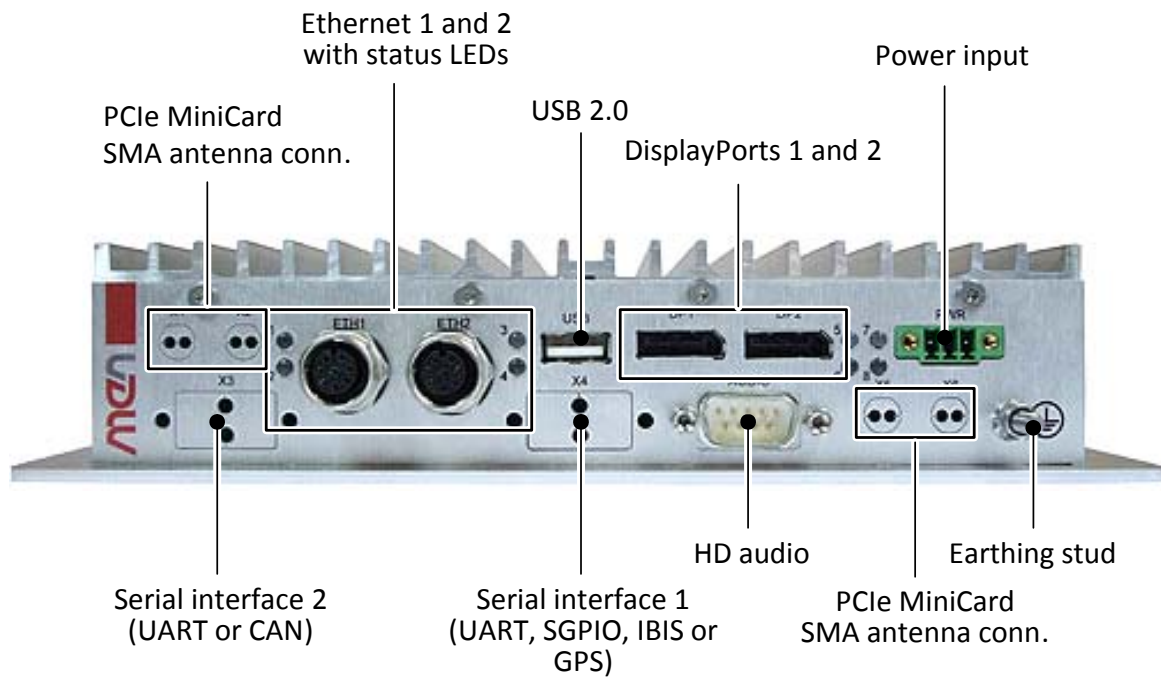
The BC50M is equipped with 2 GB of DDR3 SDRAM and offers SD card and mSATA slots. A SATA hard-disk/solid-state drive can be installed within the housing as an option. The system is designed for fanless operation at temperatures from -40 to +70°C (+85°C for up to 10 minutes), its special aluminum housing with cooling fins serves as a heatsink for the internal electronics and in this way provides conduction cooling.

The BC50M supports up to two DisplayPort® interfaces with a maximum resolution of 2560x1600 each. The DisplayPort® interfaces and all other I/O are available at the unit's front panel on standard connectors like USB, 9-pin D-Sub (HD audio and optional serial I/O), 8-pin M12 (Gigabit Ethernet) and DisplayPort®. On the inside, the system offers two PCI Express® Mini card slots with two SIM card slots. By default, one is used for each of the two PCI Express® Mini cards, but the first PCI Express® Mini card can also switch between the two SIM cards as an option. The necessary antenna connectors can be made available at the front panel.

The BC50M comes with an integrated 30W wide-range DC/DC converter and is compliant with EN 50155 (nominal input voltages 24 and 36 V) and prepared for E1 certification (nominal input voltages 12 and 24 V). The power can be switched on and off using an ignition signal on the power connector, and a shutdown-delay time after switching off the power can be adjusted by software.

The combination of the various CPU/GPU options with the available selection of external interfaces (realized via separate graphics and I/O interface boards within the system) makes for an extremely flexible system design that can quickly be tailored to a vast number of applications.

Diagram



Technical Data

CPU

- Dual-core AMD Embedded G-Series T48N
 - 1.4 GHz processor core frequency
 - Accelerated Processing Unit (APU), also includes GPU (see Graphics)

Controller Hub

- AMD A55E

Memory

- 64 KB L1 and 512 KB L2 cache
- 2 GB DDR3 SDRAM system memory
 - Soldered
 - 1066 MT/s

Mass Storage

- One SD card slot
 - Via USB
- One mSATA slot
 - Transfer rate up to 3 Gbit/s
- Serial ATA (SATA)
 - One port for hard-disk/solid-state drive mounted within the unit's housing
 - SATA Revision 3.x support
 - Transfer rates up to 600 MB/s (6 Gbit/s)

Graphics

- AMD Radeon™ HD 6310
 - Dual independent display support
 - Dual DisplayPort®
 - Maximum resolution: 2560x1600
 - Embedded in T48N APU
- 3D Graphics Acceleration
 - Full DirectX® 11 support, including full speed 32-bit floating point per component operations
 - Shader Model 5
 - OpenCL™ 1.1 support
 - OpenGL® 4.0 support
- Motion Video Acceleration
 - Dedicated hardware (UVD 3) for H.264, VC-1 and MPEG2 decoding
 - HD HQV and SD HQV support: noise removal, detail enhancement, color enhancement, cadence detection, sharpness, and advanced de-interlacing
 - Super up-conversion for SD to HD resolutions

Front I/O

- 2 DisplayPort® 1.1a interfaces
 - AUX channels and hot plug detection
- 1 HD audio
 - HD audio codec
 - Audio stereo in
 - Audio stereo out
 - SPDIF out
 - All available via 9-pin D-Sub connector
- 2 Gigabit Ethernet
 - Via M12 connectors
- 1 USB 2.0
 - Via Series A connector
- 2 SA-Adapter™ slots for serial I/O
 - 1 UART or IBIS, GPS, SGPIO
 - 1 UART or CAN bus
- 8 status LEDs
 - 4 for Ethernet link and activity status
 - 2 for general board status
 - 2 user LEDs

2 PCI Express® Mini Card slots

- For functions such as
 - Mobile service standards: GSM (2G), UMTS (3G), LTE (4G) and derivatives
 - Wireless communication: WLAN / WiFi IEEE 802.11 and derivatives
 - Positioning: GPS, GLONASS, GALILEO
- 2 SIM card slots
- PCI Express® and USB interface

Real-Time Clock

- Buffered by Gold Cap for up to 12 h
 - 72 h as an option

Electrical Specifications

- Isolation voltage 1,500 VDC
 - Ethernet port 1, Ethernet port 2, power input, system ground (USB, Display Port, Audio...)
- Supply voltage:
 - 24 VDC and 36 VDC (10 to 50.4 V input voltage range)
 - EN 50155 power interruption class S2
- Power consumption: up to 30 W

Mechanical Specifications

- Dimensions: approx. 250 mm x 220 mm x 44.1 mm
- Weight: 1.8 kg
- Front protected according to IP20

Environmental Specifications

- Temperature range (operation):
 - Depends on system configuration (CPU, PCIeMiniCards, Ethernet, USB, ...)
 - Maximum: +70°C (+85°C for 10 minutes) according to EN50155 Tx
 - Minimum: -40°C (all processors)
 - Conditions: typical power dissipation: 14.4 W (with 18W CPU T48N) with Windows® 7 operating system and 1 Gb Ethernet connection
 - Fanless operation
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to +3,000 m
- Shock: 50 m/s², 30 ms
- Vibration (function): 1 m/s², 5 Hz – 150 Hz
- Vibration (lifetime): 7.9 m/s², 5 Hz – 150 Hz
- Internal components conformally coated

MTBF

- 262,804 h @ 40°C according to IEC/TR 62380 (RDF 2000)

Safety

- PCB manufactured with a flammability rating of 94V-0 by UL recognized manufacturers

EMC

- Conforming to EN 55022 (radio disturbance), IEC 61000-4-2 (ESD) and IEC 61000-4-4 (burst)
- Prepared for certification according to e1 requirements of the German Federal Motor Transport Authority

BIOS

- InsydeH2O™ UEFI Framework

Software Support

- Windows® 7
- Windows® Embedded Standard 7
- Windows® XP Embedded
- Linux
-  For more information on supported operating system versions and drivers see [online data sheet](#).

Configuration Options

APU

- AMD T56N, 1.65 GHz Dual Core, 18W, AMD Radeon™ HD 6320
- AMD T56E, 1.65 GHz Dual Core, 18W, AMD Radeon™ HD 6250
- AMD T48N, 1.4 GHz Dual Core, 18W, AMD Radeon™ HD 6310
- AMD T48E, 1.4 GHz Dual Core, 18W, AMD Radeon™ HD 6250
- AMD T40N, 1.0 GHz Dual Core, 9W, AMD Radeon™ HD 6290
- AMD T40E, 1.0 GHz Dual Core, 6.4W, AMD Radeon™ HD 6250
- AMD T52R, 1.5 GHz Single Core, 18W, AMD Radeon™ HD 6310
- AMD T44R, 1.2 GHz Single Core, 9W, AMD Radeon™ HD 6250
- AMD T40R, 1.0 GHz Single Core, 5.5W, AMD Radeon™ HD 6250
- AMD T16R, 615 MHz Single Core, 4.5W, AMD Radeon™ HD 6250
- AMD T48L, 1.4 GHz Dual Core, 18W
- AMD T30L, 1.4 GHz Single Core, 18W
- AMD T24L, 1000 MHz Single Core, 5W

Memory

- Up to 4 GB DDR3 SDRAM system memory
- SATA hard-disk/solid state drive (mounted within housing)

Graphics

- Maximum resolution depending on GPU
 - 2560x1600 (all DisplayPort® interfaces) with Radeon™ HD 6310 and 6320
 - 1920x1200 (all DisplayPort® interfaces) with Radeon™ HD 6250 and 6290

I/O

- Antenna connectors
 - For functions like Wi-Fi, WIMAX, GSM/GPRS, UMTS, LTE in combination with PCI Express® Mini Card(s)
 - Reverse SMA connector
- Two SA-Adapter™ slots for RS232, RS422/485, IBIS, binary I/O or CAN bus

Miscellaneous

- Real-time clock
 - 72 h buffer time
- 3-axis accelerometer and 3-axis magnetometer

Electrical Specifications

- Input voltages of 48V, 72V and 110 V can be implemented on request

Mechanical Specifications

- Sides protected according to IP40

Environmental Specifications

- Temperature range (operation):
 - -40°C to 85°C (screened) with wider housing with additional cooling fins

As the product concept is very flexible, there are many other configuration possibilities. Please contact our sales team if you do not find your required function in the options. Please note that some of these options may only be available for large volumes.



For available standard configurations see online data sheet.

Product Safety



Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual is intended only for system developers and integrators, it is not intended for end users.

It describes the hardware functions of the system and connection of peripheral devices. It also provides additional information for special applications and configurations of the system.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2012-01-18
E2	Changed product name, modified chapter structure, added chapters concerning installation, changed processor and DRAM size, modifications according to new product revision	2013-04-15
E3	Added installation in 19" rack, corrected SA-Adapter installation, corrected connection of earthing cable, user LED C is now working, changed PSU input voltage range, cosmetics	2013-11-22

Conventions



This sign marks important notes or warnings concerning the use of voltages which can lead to serious damage to your health and also cause damage or destruction of the component.



This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics

Folder, file and function names are printed in *italics*.

bold

Bold type is used for emphasis.

monospace

A monospaced font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

comment

Comments embedded into coding examples are shown in green color.

[hyperlink](#)

Hyperlinks are printed in blue color.



The globe will show you where [hyperlinks](#) lead directly to the Internet, so you can look for the latest information online.

IRQ#
/IRQ

Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.

in/out

Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".



Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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MEN products are no ready-made products for end users. They are tested according to the standards given in the Technical Data and thus enable you to achieve certification of the product according to the standards applicable in your field of application.

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Since July 1, 2006 all MEN standard products comply with RoHS legislation.

Since January 2005 the SMD and manual soldering processes at MEN have already been completely lead-free. Between June 2004 and June 30, 2006 MEN's selected component suppliers have changed delivery to RoHS-compliant parts. During this period any change and status was traceable through the MEN ERP system and the boards gradually became RoHS-compliant.



WEEE Application

The WEEE directive does not apply to fixed industrial plants and tools. The compliance is the responsibility of the company which puts the product on the market, as defined in the directive; components and sub-assemblies are not subject to product compliance.

In other words: Since MEN does not deliver ready-made products to end users, the WEEE directive is not applicable for MEN. Users are nevertheless recommended to properly recycle all electronic boards which have passed their life cycle.

Nevertheless, MEN is registered as a manufacturer in Germany. The registration number can be provided on request.

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1 Product Description

This chapter gives an overview of the system.

1.1 Top View

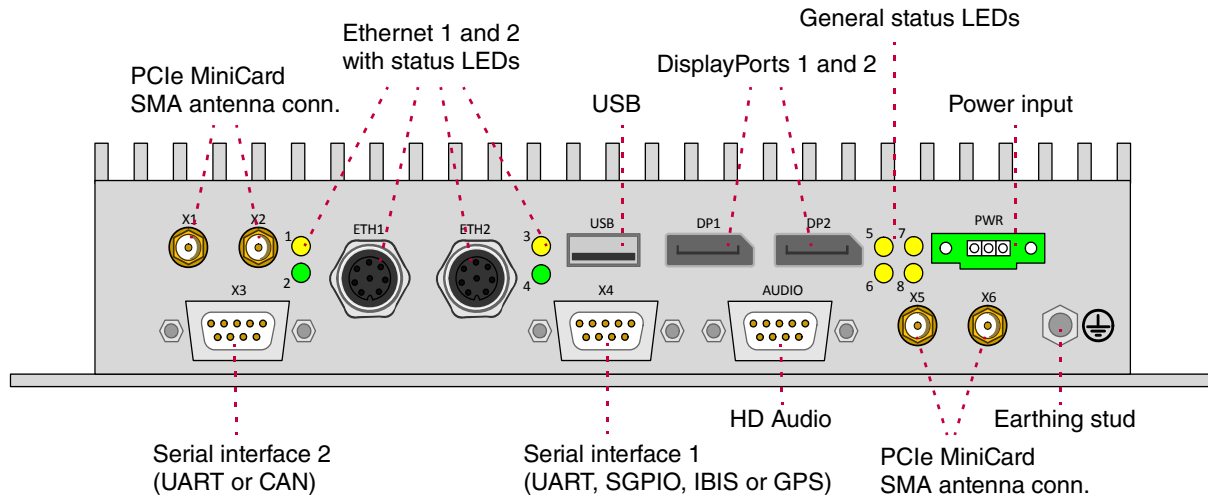
Figure 1. The BC50M - top view (without SA-Adapters and antenna connectors)



1.2 External Interfaces

The BC50M offers a multitude of connections at the front of the unit:

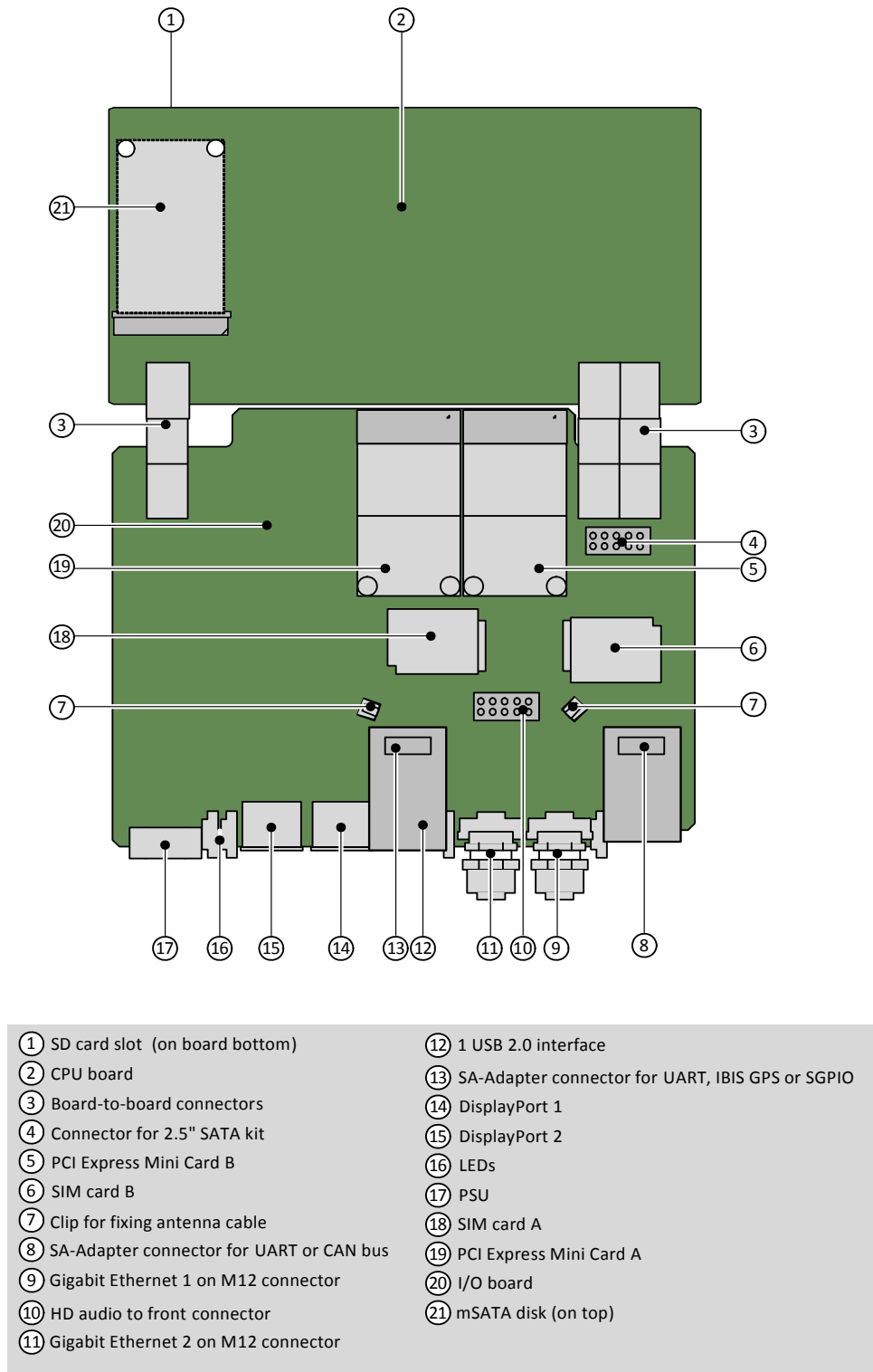
Figure 2. The BC50M– front view



All optional connectors are shown, i.e. the SMA antenna connectors and the 9-pin D-Sub connectors from the SA-Adapters.

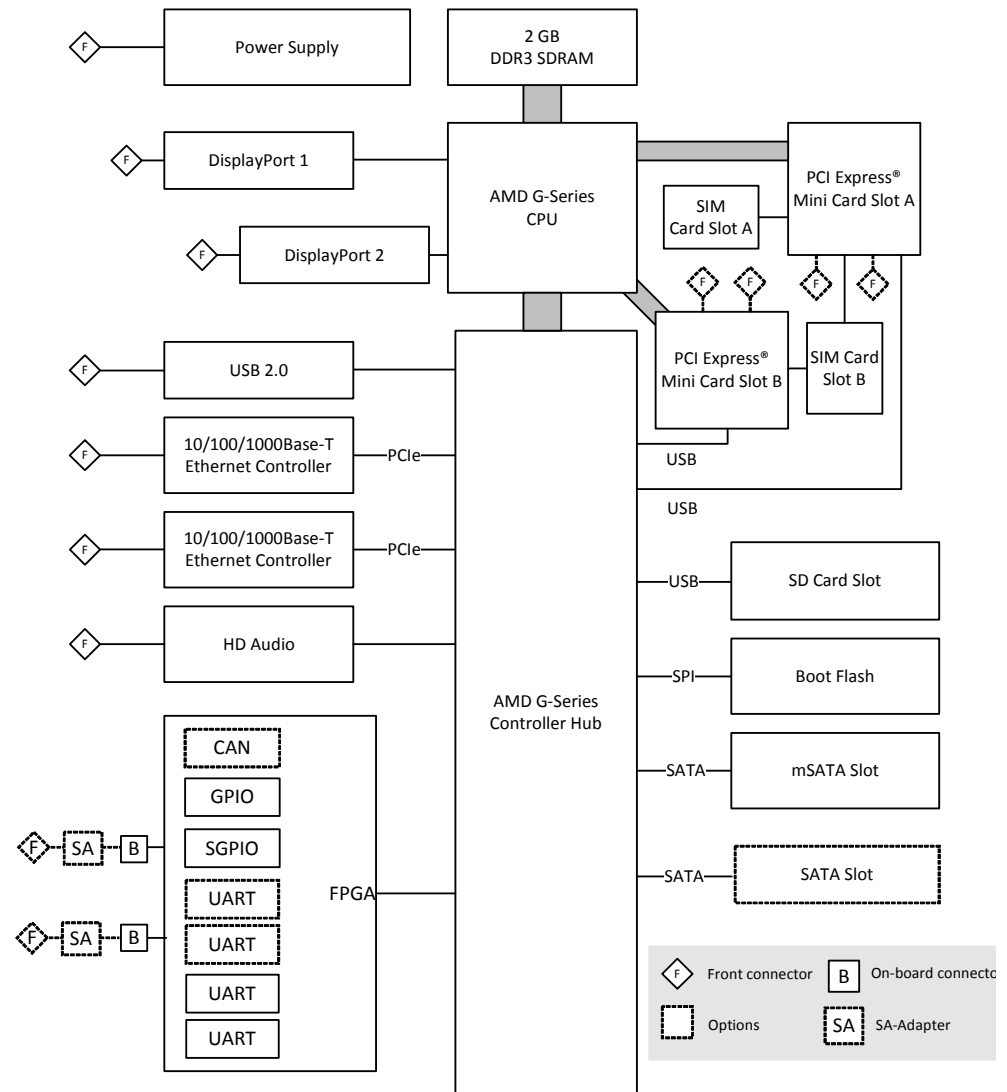
1.3 Map of the System

Figure 3. Map of the system – view of the BC50M with the bottom panel removed



1.4 Block Diagram

Figure 4. BC50M block diagram



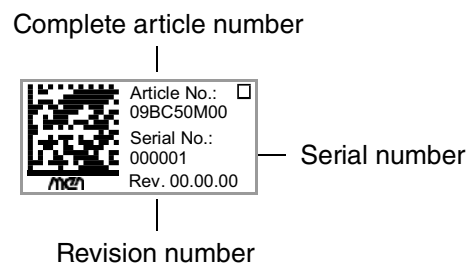
1.5 Product Identification

MEN user documentation may describe several different models and/or design revisions of the BC50M. You can find information on the article number, the design revision and the serial number on a label attached to the chassis.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.
- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 5. Label giving the product's article number, revision and serial number



2 Getting Started

2.1 Unpacking the System

After unpacking, check whether there are any transport or other damages on the system.

2.2 Configuring the Hardware

Check your hardware requirements before mounting the BC50M, since most modifications are difficult or even impossible to do when the box PC is mounted.

The following check list gives an overview on what you might want to configure. For installing the components mentioned below, the BC50M has to be opened. See [Chapter 2.2.1 Handling Internal Components on page 25](#) and [Chapter 2.2.2 Opening the BC50M on page 25](#).

☒ PCI Express Mini Cards

Two PCI Express Mini Cards for wireless functions can be installed in the BC50M. MEN offers a UMTS and a GPS card as an accessory. Please see MEN's [website](#) for ordering information.



Refer to [Chapter 2.2.4 Installing PCI Express Mini Cards on page 27](#) and [Chapter 3.11 PCI Express Mini Card Interface on page 50](#) for details on the installation and functionality of the PCI Express Mini Cards.

☒ Antenna connectors

Four antennas can be installed at the BC50M's front panel. MEN offers an HF antenna cable with U.FL connector to RP-SMA connector as an accessory. Please see MEN's [website](#) for ordering information.



Refer to [Chapter 2.2.4 Installing PCI Express Mini Cards on page 27](#) and for details on the installation of the antenna connectors.

☒ UART, GPS, IBIS extension through MEN standard SA-Adapters

The board provides two 10-pin I/O connectors for connection of two SA-Adapters for UART, GPS, IBIS or CAN functionality. MEN provides a range of standard adapters with different functionality. Please see MEN's [website](#) for ordering information.



Refer to [Chapter 2.2.5 Installing SA-Adapters on page 29](#) and [Chapter 3.9 Serial Interfaces via SA-Adapter on page 49](#) for details on the installation and functionality of the SA-Adapters.

☒ SD card



The board provides one SD card slot and a 4 GB SD card as an accessory.
Please see MEN's [website](#) for ordering information.



Refer to [Chapter 2.2.6 Installing an SD Card on page 31](#) for information on how to install the SD card.

☒ mSATA disk



The board provides one mSATA disk slot and an 8 GB mSATA disk as an accessory.
Please see MEN's [website](#) for ordering information.



Refer to [Chapter 2.2.7 Installing an mSATA Drive on page 32](#) for information on how to install the mSATA disk.

2.2.1 Handling Internal Components



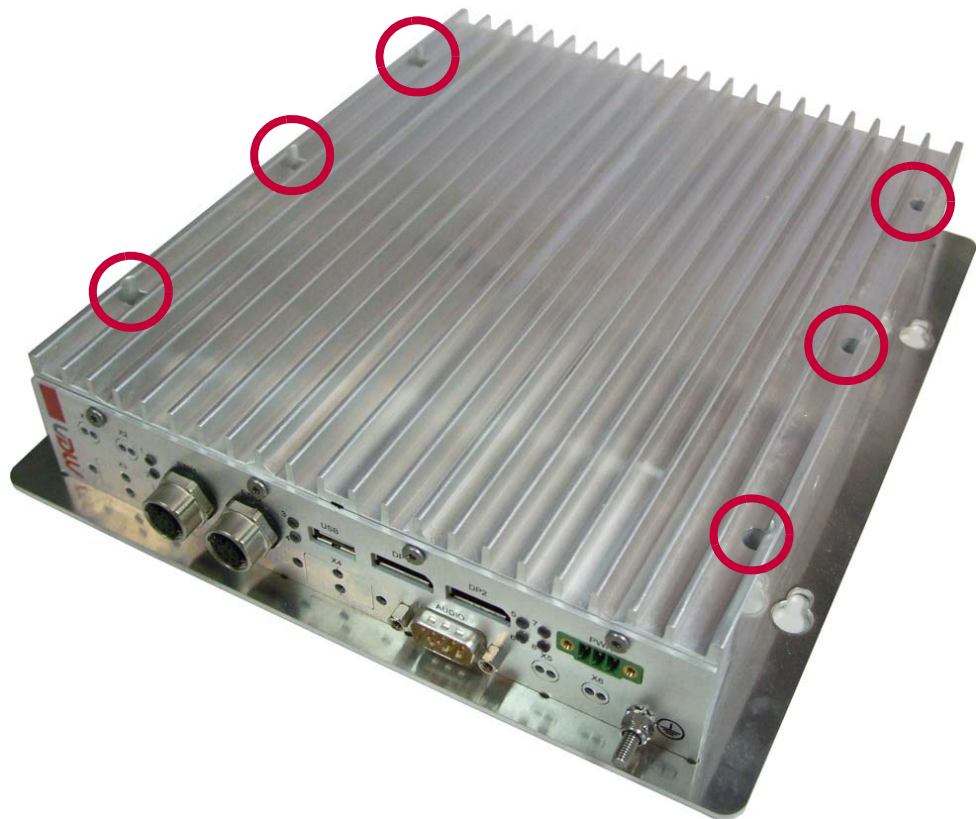
Please observe the instructions concerning electrostatic discharge whenever you work on the inside of the computer system. See [Chapter Electrostatic Discharge \(ESD\)](#) on page 9.

2.2.2 Opening the BC50M

The PCI Express Mini Cards, the SA-Adapters, the SIM cards, the mSATA slot and SD card slot of the BC50M can be accessed after opening the housing.

- ☒ For this purpose, remove the system's bottom panel fixed by six M3x16 TX10 Torx screws (screws are accessible from the system's top).

Figure 6. Screw positions on top of the BC50M



2.2.3 Removing the Rear Panel

- ☑ To access the SD card slot, remove the rear panel of the unit fixed by four M3x6 TX8 Torx screws.

Figure 7. Screw positions at the rear of the BC50M

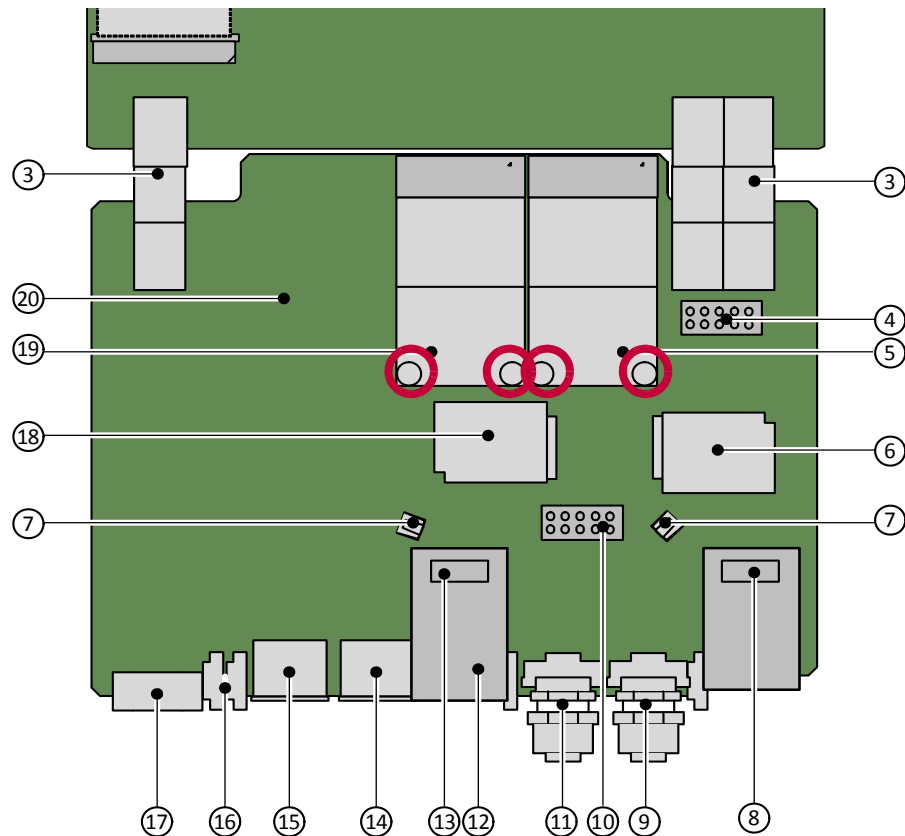


2.2.4 Installing PCI Express Mini Cards

Within its housing, the BC50M provides two PCI Express Mini card slots. The M2.5x8 screws required for installation are already screwed onto the board. Carry out the following steps to install a PCI Express Mini card.

- ☑ Untighten and remove the screws from the spacers (highlighted in red).

Figure 8. Installing a PCI Express Mini card (rear part of BC50M's interior shown)



- ☑ Insert the PCI Express Mini card carefully at a 30° angle.
- ☑ Make sure that all the contacts are aligned properly and the card is firmly connected to the connector.
- ☑ Fix the card using the two screws removed before.

Antenna Connectors

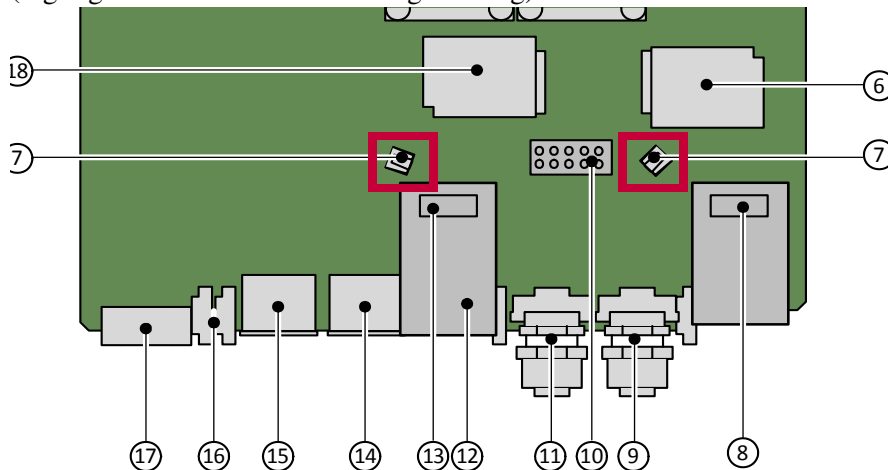


MEN offers an HF antenna cable with U.FL connector to RP-SMA connector as an accessory. See MEN's [website](#) for ordering information.

Before being able to install the antenna on the BC50M's front panel, you have to break out the cover of the antenna slot, using a screw driver or a similar tool.



There are two mounting clips for fixing the antenna cable on the BC50M's PCB (highlighted in red in the following drawing).



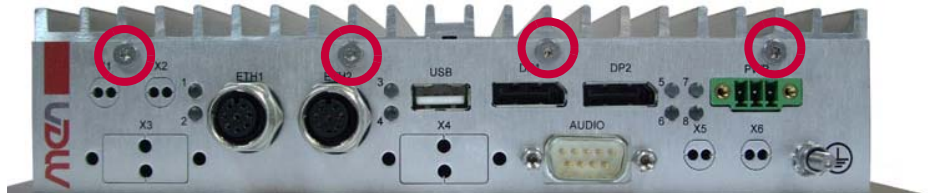
Note: There is only one position in which the antenna can be completely inserted into the front panel slot. When properly inserted the antenna is fixed and cannot be turned anymore.

2.2.5 Installing SA-Adapters

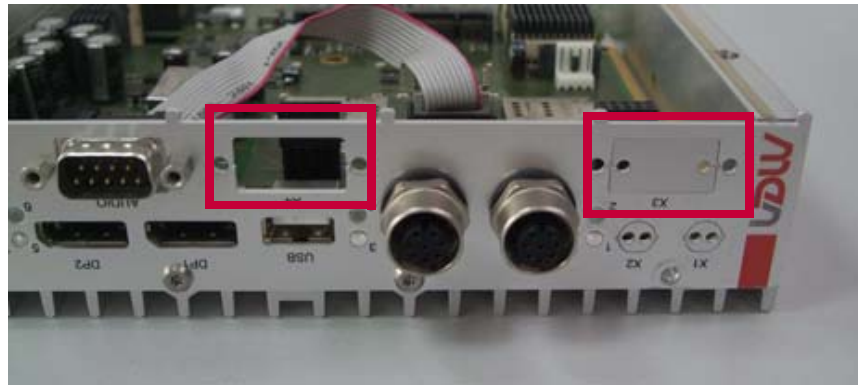
Two SA-Adapters can be mounted in the BC50M on the 10-pin receptacle for slots X3 and X4.

Carry out the following steps to install the SA-Adapters:

- ☑ Remove the front panel which is fixed by four M3x6 TX8 Torx screws.



- ☑ Break out the covers of the front panel slots.

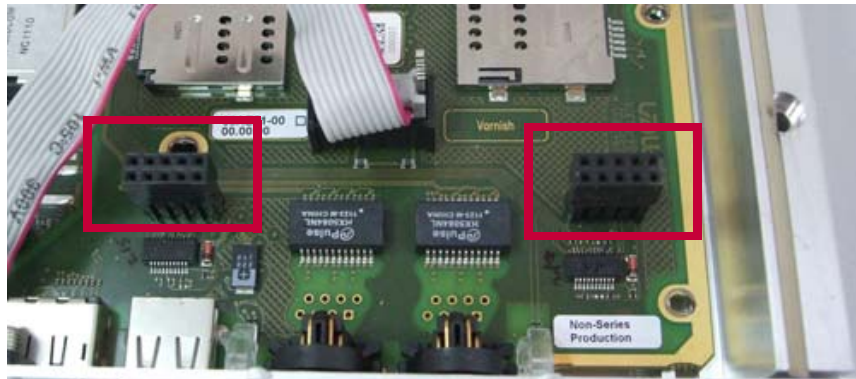


- ☑ Make sure that the adapter matches the standard dimensions for SA-Adapters. (See also installation hints in the adapter's user manual or the list of compatible accessories in the BC50M data sheet on MEN's [website](#).)

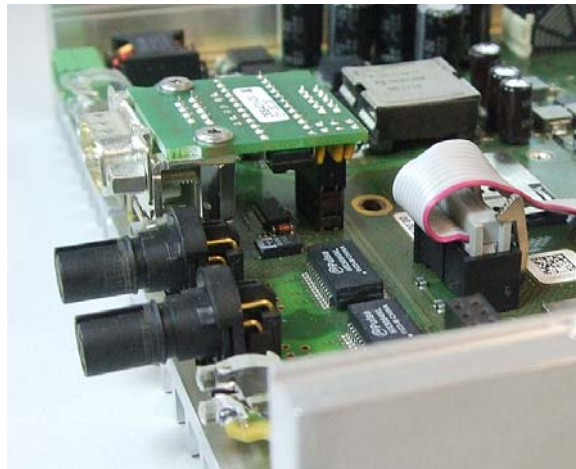
- ☑ Remove the two front panel screws of the SA-Adapter.



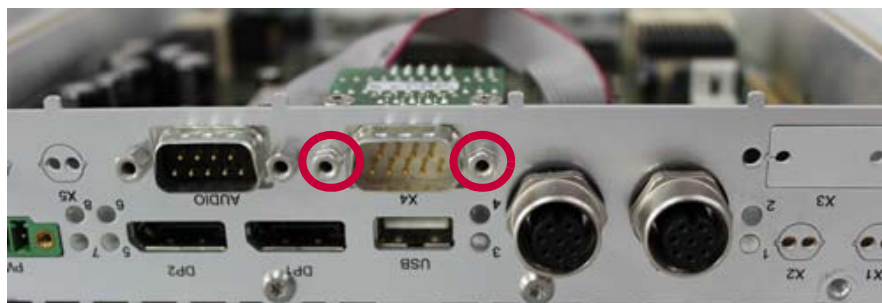
- ☑ Carefully align the SA-Adapter with the 10-pin connectors on the BC50M.



- ☑ Press the SA-Adapter firmly onto the BC50M.



- ☑ Carefully align the front panel with the front connectors and the LEDs.
- ☑ Screw the front panel back onto the BC50M.
- ☑ Screw the SA-Adapter tightly to the BC50M front panel using the two pan-head screws removed before.



2.2.6 Installing an SD Card

Within its housing, the BC50M provides one SD card slot. Carry out the following steps to install an SD card.

- ☑ The SD card slot is positioned at the edge of the system, wedged between the PCB and the top of the housing.
- ☑ Turn the SD card in a way that the contacts are facing down and the cut edge is at the right side.

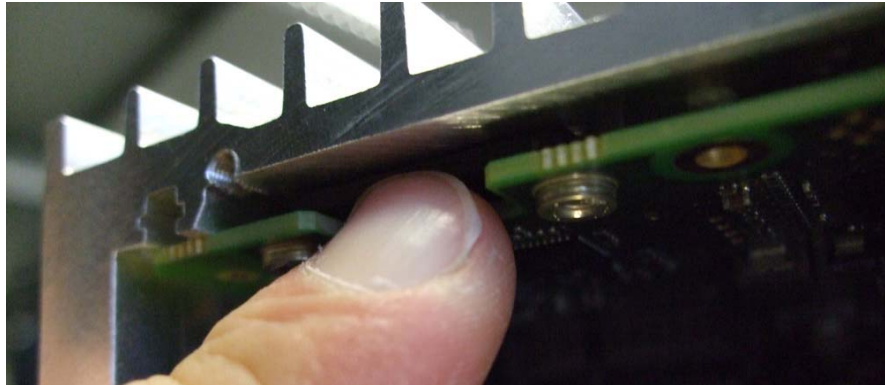


- ☑ Insert the SD card into the slot with the contacts facing to the PCB and the cut edge to the right side.



- ☑ Make sure that it clicks into place properly.

- ☑ To eject the SD card, push it until it springs out, then simply pull it out.



2.2.7 Installing an mSATA Drive

Within its housing, the BC50M provides one mSATA slot. Two M2.5x8 screws and suitable spacers are provided with the BC50M.

- ☑ Insert the mSATA drive carefully at a 30° angle.



- ☑ Make sure that all the contacts are aligned properly and the card is firmly connected to the mSATA connector.
- ☑ Align the spacers and the holes and insert the screws into the spacers from above the mSATA disk.

- ☑ Fix the card by tightening the screws.



2.3 Mounting the BC50M



- Do not install the system near any heat sources (e.g. radiators, heat registers).
- Keep the system away from liquids. Avoid exposure to dripping or splashing.
- Keep a free space of 15 cm around the housing to ensure cooling (except on the mounting side).
- The connector side should face down.

The BC50M's bottom plate provides four mounting holes for installation. Use M5 countersink head screws. Refer to [Figure 9, Front panel dimensions and mounting hole positions](#) for exact measurements.

Figure 9. Front panel dimensions and mounting hole positions

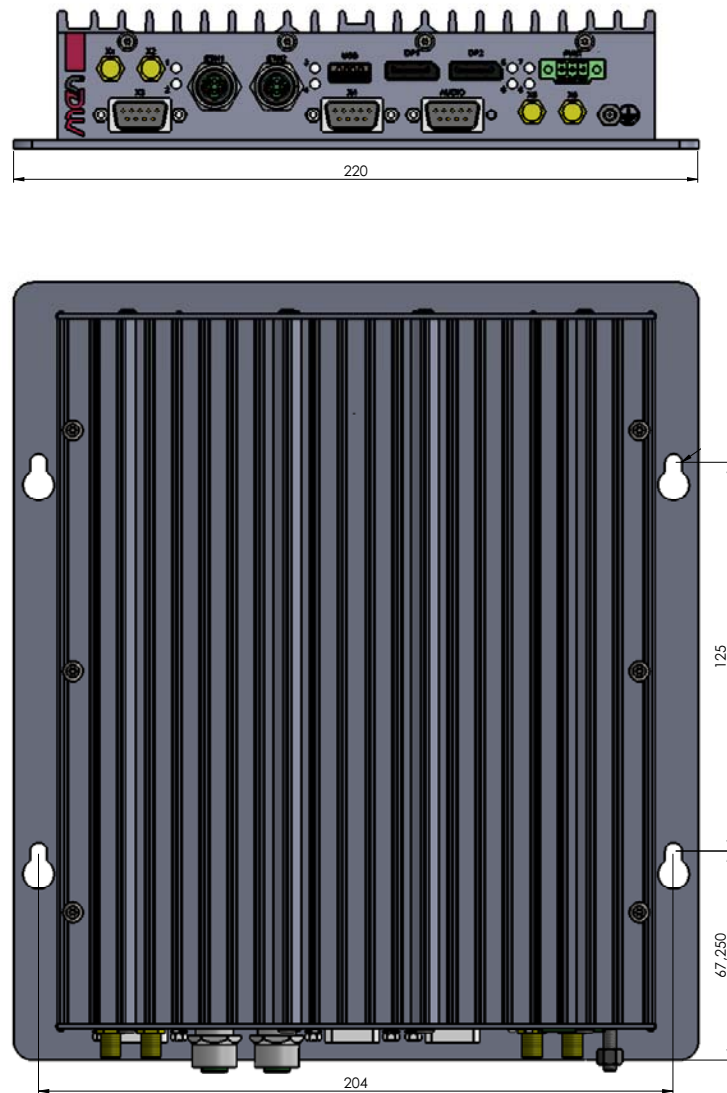
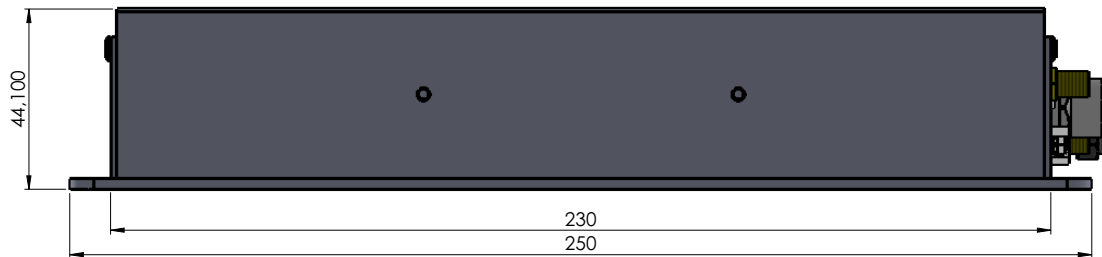


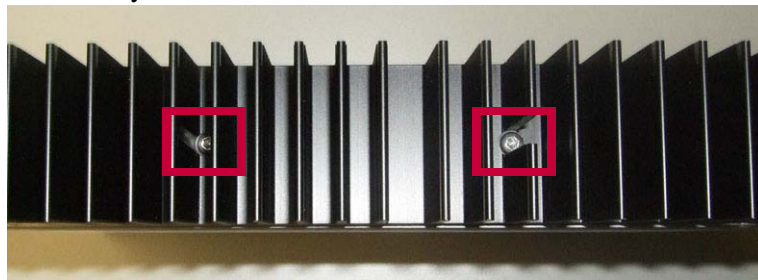
Figure 10. Side view

2.3.1 Installing the BC50M in a 19" Rack



MEN offers a mounting kit which makes it possible to install the BC50M in a 19" rack (05BC01-00). Please see MEN's [website](#) for more information.

- ☑ Remove the BC50M's bottom panel as described in [Chapter 2.2.2 Opening the BC50M on page 25](#).
- ☑ Install the two heatsinks supplied with the kit at the sides of the BC50M using two M3x10 TX10 Torx screws for each heat sink. The screws are included in the delivery of the 05BC01-00 kit.

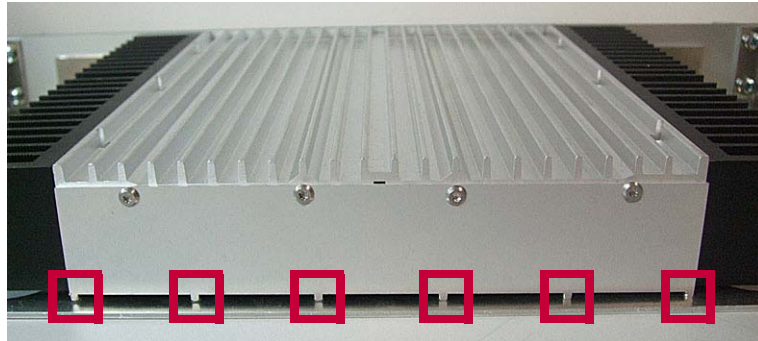


- ☑ Remove the right and the left screw fastening the front panel.



- ☑ Insert the box PC into the opening in the kit's front panel in a 45° angle.

- ☑ Take care that the small studs at the bottom of the front and rear panel of the box PC are aligned with the corresponding holes in the bottom plate of the mounting kit.



- ☑ Press the BC50M down onto the bottom plate.
- ☑ Screw the BC50M onto the kit's bottom plate using the 6 screws removed before.
- ☑ Fix the BC50M at the kit's front panel using two M3x6 TX8 Torx screws.



- ☑ Fasten the BC50M in the frame in the 19" switching cabinet using four M6x16 screws.

2.4 Connecting an Earthing Cable

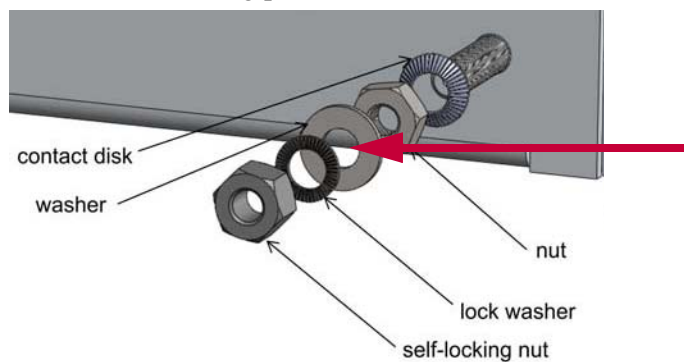
The BC50M features an earthing stud on the bottom right (see [Figure 2, The BC50M– front view](#)). An earth connection is essential for the system to meet its EMC specifications.



An earthing cable has to be connected to the earthing stud before any other connections! For disassembling the system, the earthing cable has to be detached last.

Carry out the following steps to connect an earthing cable:

- ☑ Take an earthing cable with a cross section of at least 0.75 mm².
- ☑ Slide the cable onto the stud between the washer and the lock washer as indicated in the following picture:



- ☑ Fasten the cable by tightening the nut.

2.5 Starting up the System

Before switching on the system make sure that all peripheral devices are connected to the system before connecting an external power supply and switching on the system.

You can use the following check list when installing the unit for the first time and with minimum configuration.

- ☑ Connect a USB keyboard and mouse to the USB connector at the front panel. Since the system offers only one USB connection, use a USB hub.
- ☑ Connect a flat-panel display capable of displaying the resolution of 1024x786 to the DP1 DisplayPort connector of the BC50M.
- ☑ Power up the system. See [Chapter 3.1 Power Supply on page 39](#).
- ☑ You can start up the BIOS setup menu by hitting the <F2> key.
- ☑ Now you can make configurations in BIOS.
- ☑ Observe the installation instructions for the respective software.

2.6 Installing Operating System and Driver Software

The BC50M supports Windows 7, Windows Embedded Standard 7, Windows XP Embedded and Linux. By default, no operating system is installed.

For a detailed description on how to install operating system and driver software please refer to the respective documentation.



You can find any software available on MEN's [website](#).

3 Functional Description

The following describes the individual functions of the system and their configuration. There is no detailed description of the individual controller chips and the CPU. They can be obtained from the data sheets or data books of the semiconductor manufacturer concerned ([Chapter 7.1 Literature and Web Resources on page 59](#)).

3.1 Power Supply

The BC50M is supplied with a nominal input voltage of 24 VDC or 36 VDC (10 to 50.4 V input voltage range) according to EN 50155 via a 3-pin COMBICON connector. Other input voltage ranges can be implemented on request.

The onboard power supply generates all the necessary internal voltages.

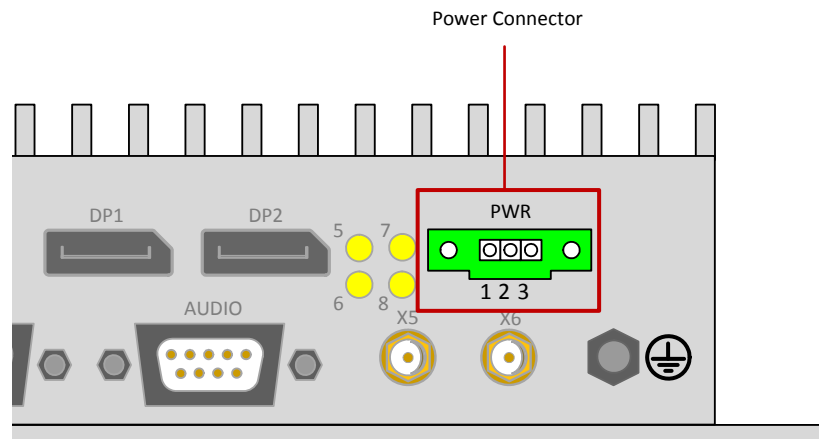
Connector type:

- 3-pin COMBICON receptacle (Phoenix Contact 1843800 MC 1,5/ 3-GF-3,5)

Mating connector:

- 3-pin COMBICON plug, e.g., Phoenix Contact 1863314 MCVR 1,5/ 3-STF-3,5

Table 1. Pin assignment of PSU connector



1	POWERCON_IN	Power input
2	POWERCON_GND	Power input ground
3	IGNITIONCON	Ignition

3.1.1 Ignition

Using the ignition pin, the start-up and shut-down of the BC50M can be controlled.

The ignition pin (pin 3) can be permanently connected to the power input pin (pin 1). In this case the BC50M is starting up as soon as the supply voltage is connected and shut down as soon as the supply voltage is disconnected.

If the ignition pin (pin 3) is connected to the power input pin (pin 1) via a switch or a controller, switching on and off of the BC50M can be controlled without having to disconnect the power supply. A shut-off delay can be set so that the operating system of the BC50M can shut down in a controlled way.

When the ignition pin is connected to VBAT, the BC50M is switched off at once without a delay for shutting down the operating system.

3.2 Real-Time Clock

The BC50M is equipped with a real-time clock integrated in the chipset. For data retention during power-off, the RTC is backed up by a Gold Cap that gives an autonomy of approx. 12 hours (as an option 72 hours) when fully loaded. Under normal conditions, replacement should be superfluous during lifetime of the board.

3.3 Processor Core

The BC50M can be equipped with several AMD APUs (Accelerated Processing Units). The default APU is the T48N (marked in gray in the following table).

Table 2. Processor core options on BC50M

Model	Clock Speed, No. of Cores	Cache	Max. TDP	DDR3 Speed	Graphics
AMD T56N	1.65 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1333	Radeon HD 6320
AMD T52R	1.5 GHz single core	L1 cache 64 KB, L2 cache 512 kB	18 W	DDR3-1333	Radeon HD 6310
AMD T48N	1.4 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	18 W	DDR3-1066	Radeon HD 6310
AMD T40N	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	9 W	LVDDR3-1066	Radeon HD 6310
AMD T44R	1.2 GHz single core	L1 cache 64 KB, L2 cache 512 kB	9 W	LVDDR3-1066	Radeon HD 6250
AMD T40E	1.0 GHz dual core	L1 cache 64 KB, L2 cache 512 kB x2	6.4 W	LVDDR3-1066	Radeon HD 6250
AMD T40R	1.0 GHz single core	L1 cache 64 KB, L2 cache 512 kB	5.5 W	LVDDR3-1066	Radeon HD 6250
AMD T16R	615 MHz sin- gle core	L1 cache 64 KB, L2 cache 512 kB	4.5 W	LVDDR3-1066	Radeon HD 6250
AMD T56E	1.65 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1333	Radeon HD 6250
AMD T48E	1.4 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1066	Radeon HD 6250
AMD T48L	1.4 GHz Dual Core	L1 cache 64KB, L2 cache 512kB x2	18W	DDR3-1066	N/A
AMD T30L	1.4 GHz Sin- gle Core	L1 cache 64KB, L2 cache 512kB	18W	DDR3-1066	N/A
AMD T24L	1000 MHz Single Core	L1 cache 64KB, L2 cache 512kB	5W	LVDDR3-1066	N/A

Note: T56N and T40N are models enabled by AMD Turbo Core technology, up to 10% clock speed increase is planned.

3.3.1 Thermal Considerations

The operating temperature range of the BC50M depends on the system configuration (CPU, PCIeMiniCards, Ethernet, USB, ...)

The power dissipation of the system also depends on the environmental conditions. It has a typical power dissipation of 14.4 W in a configuration with an 18W T48N CPU with Windows 7 operating system and 1 Gb Ethernet connection.

The system is designed for a maximum operating temperature of +70°C. A temperature of +85°C is supported for up to 10 minutes according to class Tx (EN 50155). The minimum temperature is -40°C for all processors.

As an option, a wider housing with additional cooling fins is available, enabling permanent operation at +85°C.

3.4 Memory and Mass Storage

3.4.1 DRAM System Memory

The standard model of the BC50M is equipped with 2 GB of DDR3 SDRAM. Up to 4 GB are supported. The graphics controller of the BC50M has no own memory and so uses 256 MB of the system memory by default. Other values can be set using a BIOS item in the sub-menu Video Configuration (possible settings 64MB, 128MB, 256MB or 512MB).

3.4.2 Boot Flash

The BC50M is equipped with a boot Flash containing its BIOS.

3.4.3 SD Card Slot

Within its housing, the BC50M provides one SD card slot.

See [Chapter 2.2.6 Installing an SD Card on page 31](#) for information on how to install the SD card.

3.4.4 mSATA slot

Within its housing, the BC50M provides one mSATA slot.

See [Chapter 2.2.7 Installing an mSATA Drive on page 32](#) for information on how to install an mSATA disk.

3.4.5 SATA Hard Disk (Optional)

The BC50M offers the possibility to install an additional SATA hard disk in the housing on a special mounting frame.

Please [contact MEN's sales team](#) for further information.

3.5 Graphics

3.5.1 Graphics Processing Unit

The standard model of the BC50M is equipped with an AMD APU (Accelerated Processing Unit) that also includes an AMD Radeon 6310 as a GPU (Graphics Processing Unit). For other GPU options please refer to [Chapter 3.3 Processor Core on page 41](#).

3.5.2 DisplayPort Interfaces

Two DisplayPort interfaces are available at the front panel. The maximum supported resolution is 2560x1600 at 60 Hz. The interfaces offer AUX channel support and hot plug detection.

Connector type:

- 20-pin DisplayPort receptacle

Mating connector:

- 20-pin DisplayPort plug

Table 3. Pin assignment of 20-pin DisplayPort connector

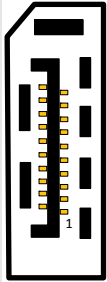
	20	POWER	19	RETURN PWR
	18	DP_HOTPLUG	17	DP_AUX-
	16	GND	15	DP_AUX+
	14	CONFIG2	13	CONFIG1
	12	LANE_3-	11	GND
	10	LANE_3+	9	LANE_2-
	8	GND	7	LANE_2+
	6	LANE_1-	5	GND
	4	LANE_1+	3	LANE_0-
	2	GND	1	LANE_0+

Table 4. Signal mnemonics of 20-pin DisplayPort connector

Signal	Direction	Function
GND	-	Ground
DP_AUX-, DP_AUX+	in/out	Bi-directional half-duplex auxiliary channels for device management and device control
CONFIG1, CONFIG2	-	Connected to Ground
DP_HOTPLUG	in	Hot Plug Detect
LANE_[3..0]+, LANE_[3..0]-	out	Main Link data lanes
POWER	out	Power for connector (3.3 V, 500 mA)
RETURN PWR	-	Return for Power

3.5.3 Other Graphics Interfaces



MEN offers a starter kit including a DisplayPort to DVI adapter. For ordering details please consult MEN's [website](#).

In addition, many third-party suppliers offer active adapters from DisplayPort to other graphics interfaces. The maximum resolution depends on the adapter used. Supported interfaces include:

- HDMI
- Single-link DVI
- Dual-link DVI
- VGA



Note: Passive adapters are not supported by the BC50M!

3.6 USB Interface

The BC50M provides one USB 2.0 interface at the front panel.

Connector types:

- 4-pin USB Series A receptacle according to Universal Serial Bus Specification Revision 1.0
- Mating connector:
4-pin USB Series A plug according to Universal Serial Bus Specification Revision 1.0

Table 5. Pin assignment of USB front-panel connectors

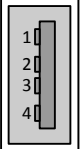
	1	+5V
	2	USB_D-
	3	USB_D+
	4	GND

Table 6. Signal mnemonics of USB front-panel connectors

Signal	Direction	Function
+5V	out	+5 V power supply
GND	-	Digital ground
USB_D+, USB_D-	in/out	USB lines, differential pair

3.7 Ethernet Interface

Each of the two controllers has its own EEPROM to store the MAC address etc.



The unique MAC address is set at the factory and should not be changed. Any attempt to change this address may create node or bus contention and thereby render the board inoperable. The naming of the interfaces may differ depending on the operating system. The MAC addresses on BC50M are:

- ETH1: 0x 00 C0 3A B1 Cx xx to 0x 00 C0 3A B1 FF FF
- ETH2: 0x 00 C0 3A B2 xx xx to 0x 00 C0 3A B2 3F FF

where "00 C0 3A" is the MEN vendor code and "B1" and "B2" are the MEN product codes. The last four digits depend on the interface and the serial number of the BC50M's system core board. Its serial number is added to the offset, for example for ETH1:

Serial number 0042 (0x2A): 0x C0 00 + 0x 00 2A = 0x C0 2A.

Please note that due to the structure of the BC50M, the serial number of the unit's system core board is different from the serial number of the entire BC50M unit. For the unit's overall serial number please refer to [Chapter 1.5 Product Identification on page 22](#).

Connector type:

- 8-pin M12 receptacle, female, A-coded 90° (Phoenix Contact 1436974 SACC-DSIV-FS-8CON-L90 SCO)

Mating connector:

- 8-pin M12 plug, male, A-coded

MEN offers a starter kit including an M12 to RJ45 adapter for making the Ethernet interfaces available on standard Ethernet connectors. For ordering details please consult MEN's [website](#).



Table 7. Pin assignment of Ethernet front-panel connectors

		1000Base-T	10/100Base-T
	1	BI_DC-	
	2	BI_DD+	
	3	BI_DD-	
	4	BI_DA-	TX-
	5	BI_DB+	RX+
	6	BI_DA+	TX+
	7	BI_DC+	-
	8	BI_DB-	RX-





Table 8. Signal mnemonics of Ethernet front-panel connectors

Signal	Direction	Function
BI_Dx+/-	in/out	Differential pairs of data lines for 1000Base-T
RX+/-	in	Differential pair of receive data lines for 10/100Base-T
TX+/-	out	Differential pair of transmit data lines for 10/100Base-T

3.7.1 Ethernet Status LEDs

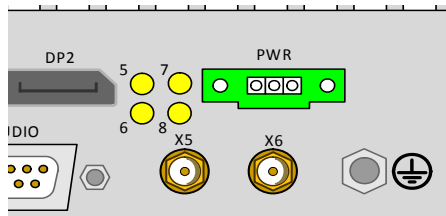
The BC50M provides a total of four Ethernet status LEDs, two for each Ethernet channel. They signal the link and activity status (different LED behavior can be implemented on demand).





Table 9. Ethernet status LED

LED	Description	LED	Description
1 	Port 1 activity	3 	Port 2 activity
2 	Port 1 link	4 	Port 2 link

3.8 General Status LEDs

In addition to the four Ethernet status LEDs, the BC50M provides four general status LEDs. One of them signals whether the onboard power generated by the BC50M's on-board DC/DC converter is within valid range, another signals the system status. User LED A and User LED C are connected to a GPIO line each and can be used freely depending on an application's requirements. See [Chapter 5.1 GPIO Controller Instance 0](#) for information on how to access the LEDs.

Figure 11. General status LEDs on the BC50M's front panel (shown partially)**Table 10.** General status LEDs (as depicted above)

LED	Description	LED	Description
5 	User LED A	7 	Onboard 12V OK
6 	User LED B / Status	8 	User LED C

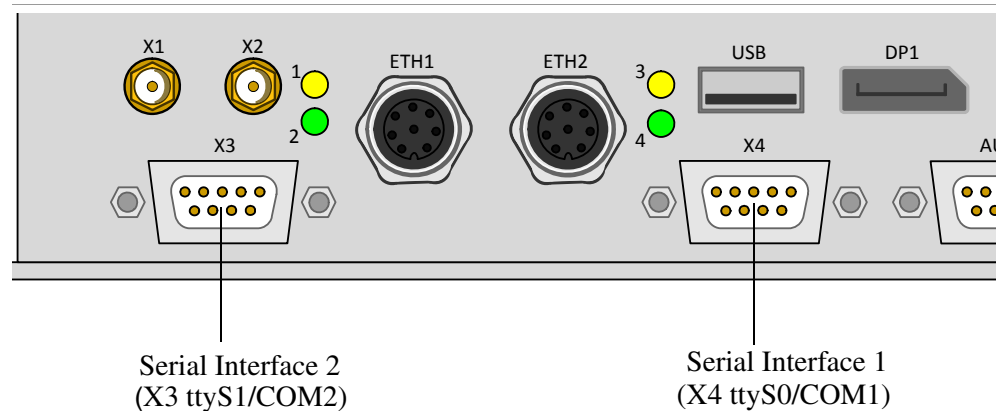
3.9 Serial Interfaces via SA-Adapter

The BC50M offers the possibility to provide two serial interfaces at the front of the BC50M using MEN standard SA-Adapters. This way, a serial interface can be used which can be flexibly configured as needed.

SA-Adapter slot 1 can be used for UART, IBIS, GPS or SGPIO while slot 2 can be used for UART or CAN bus functionality (for CAN bus functionality a special product version is required).

If you use the 08SA15-00 SA-Adapter with SGPIO functionality in slot 1 you have to change a setting in the FPGA to switch from UART to SGPIO. See [Chapter 5.2 GPIO Controller Instance 2](#) on page 56.

Figure 12. Position of serial interfaces on BC50M front



See [Chapter 2.2.5 Installing SA-Adapters](#) on page 29 for installation instructions.



See MEN's [website](#) for a list of SA-Adapters which can be used on the BC50M.

Please [contact MEN's sales team](#) for information about possible configurations and special board versions.

3.10 HD Audio

The BC50M features a high definition audio interface implemented via the Realtek ALC268 codec and available on a standard 9-pin D-Sub connector at the front panel.

Table 11. Pin assignment of the HD audio interface

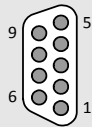
	9	AUDIO_IN_R	5	AUDIO_SPDIF
	8	AUDIO_GND	4	AUDIO_IN_L
	7	AUDIO_OUT_R+	3	AUDIO_OUT_R-
	6	AUDIO_OUT_L-	2	AUDIO_GND
			1	AUDIO_OUT_L+

Table 12. Signal mnemonics of the HD audio interface

Signal	Direction	Description
AUDIO_EXT_OUT_L±/R±	out	Line out, left and right, differential signal pairs
AUDIO_EXT_IN_L/R	in	Line in, left and right
AUDIO_EXT_GND	-	Analog ground
AUDIO_EXT_SPDIF	out	S/PDIF output

3.11 PCI Express Mini Card Interface

The BC50M supports the PCI Express Mini Card standard. Its two PCI Express Mini Card slots are located within the housing. Please refer to [Figure 3, Map of the system – view of the BC50M with the bottom panel removed on page 20](#) for their exact positions. As an option, the BC50M can also be equipped with PCI Express Mini Card slots compatible with half-size modules.

See [Chapter 2.2.4 Installing PCI Express Mini Cards on page 27](#) for information on how to install the PCI Express Mini Cards in the BC50M.

The cards use either a single PCI Express lane (x1) or a USB connection; the BC50M supports both. It is equipped with two 52-pin standard PCI Express Mini Card connectors. The following standard signals are supported (signal directions according to PCI Express Mini Card standard):

Table 13. Pin assignment of 52-pin PCI Express Mini Card connector

Pin	Signal	Pin	Signal
51	Reserved	52	+3.3Vaux
49	Reserved	50	GND
47	Reserved	48	+1.5V
45	Reserved	46	LED_WPAN#
43	GND	44	LED_WLAN#
41	+3.3Vaux	42	LED_WWAN#
39	+3.3Vaux	40	GND
37	GND	38	USB_D+
35	GND	36	USB_D-
33	PETp0	34	GND
31	PETn0	32	SMB_DATA
29	GND	30	SMB_CLK
27	GND	28	+1.5V
25	PERp0	26	GND
23	PERn0	24	+3.3Vaux
21	GND	22	PERST#
19	Reserved	20	W_DISABLE#
17	Reserved	18	GND
Mechanical Key			
15	GND	16	UIM_VPP
13	REFCLK+	14	UIM_RST
11	REFCLK-	12	UIM_CLK
9	GND	10	UIM_DATA
7	CLKREQ#	8	UIM_PWR
5	Reserved	6	1.5V
3	Reserved	4	GND
1	WAKE#	2	+3.3Vaux

Table 14. Signal mnemonics of 52-pin PCI Express Mini Card connector

	Signal	Direction	Function
Power	GND	-	Ground
	+3.3Vaux	out	3.3V source
	1.5V	out	1.5V source
SIM card	UIM_PWR	in	SIM card power
	UIM_DATA	in/out	SIM card data
	UIM_CLK	in	SIM card clock
	UIM_RST	in	SIM card reset
	UIM_VPP	in	not connected
PCI Express	REFCLK-/REFCLK+	out	PCI Express differential reference clock
	PERn0/PERp0	in	PCI Express receive signals
	PETn0/PETp0	out	PCI Express transmit signals
Auxiliary Signals	CLKREQ#	in	Clock request
	PERST#	out	Reset for the Mini Card
	W_DISABLE#	out	Wireless disable
	WAKE#	in	Wake signal
	SMB_CLK	out	System management bus clock
	SMB_DATA	in/out	System management bus data
USB	USB_D-	in/out	USB line
	USB_D+	in/out	USB line
Communications - specific signals	LED_WWAN#	in	not connected
	LED_WLAN#	in	not connected
	LED_WPAN#	in	not connected

Please refer to the PCI Express Mini Card Specification for further details. See [Chapter 7.1 Literature and Web Resources on page 59](#).

3.11.1 SIM Card Slots

The BC50M offers two SIM card slots for the two PCI Express Mini Card slots. Please refer to [Figure 3, Map of the system – view of the BC50M with the bottom panel removed on page 20](#) for their exact positions. The default setting has Mini Card A connected to SIM card A and Mini Card B to SIM card B.

However, both SIM card slots can be connected to PCI Express Mini Card A if needed. The necessary switching is performed by software via the SIMA_SW and SIMB_SW lines. See [Chapter 5.1 GPIO Controller Instance 0 on page 55](#) for information on how to switch the SIM cards.

Figure 13. SIM card switching option

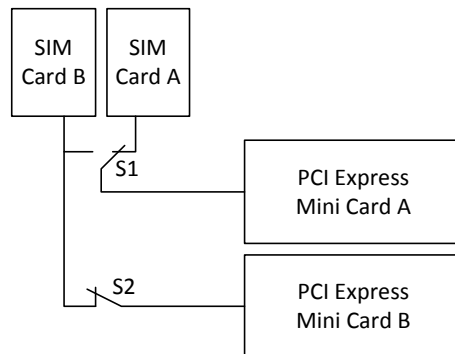


Table 15. SIM card switching option

SIMA_SW	SIMB_SW	PCI Express Mini Card A connected to	PCI Express Mini Card B connected to
0	0	SIM card A	SIM card B
0	1	SIM card A	-
1	0	-	SIM card B
1	1	SIM card B	-

4 Organization of the Board

4.1 SMBus Devices

The controller hub of the BC50M has two SMB controllers. The devices responsible for board supervision and hardware control (SPD, BC) are connected to SMB0. The devices related to information and board functions (e.g. EEPROMs, sensors, GPIO controllers) are connected to SMB1.

Table 16. *SMBus devices*

SMBus	8-Bit-Address	7-Bit-Address	Function
0	0xA0	0x50	SPD EEPROM
0	0xA2	0x51	SPD EEPROM for stacked memory
0	Defined by PIC software		BC (PIC)
1	0xAE	0x57	Board information EEPROM with thermal sensor

5 Using the BC50M with MDIS5 Software



This chapter gives specific information on how to use the BC50M with the MDIS5 software. For details about installation and usage of MDIS5 please refer to the respective MDIS5 user manual. See MEN's [website](#) for detailed information and documentation of MDIS5.

The following describes how to switch the PCI Express Mini Cards and the SIM cards (see [Chapter 3.11.1 SIM Card Slots on page 53](#)) and between UART and SGPIO if you want to use an SGPIO interface (SA-Adapter 08SA15-00, see [Chapter 3.9 Serial Interfaces via SA-Adapter on page 49](#)).

The switching is done using two GPIO controller instances. They are marked in blue writing in the following chameleon table.

Table 17. Chameleon table

Name	Device	Variant	Revision	Interrupt	Group	Instance	BAR	Offset	Size
16Z125_UART	125	0	C	4	0	0	0	3F8	8
16Z125_UART	125	0	C	3	0	1	0	2F8	8
16Z125_UART	125	0	C	7	0	2	0	3E8	8
16Z125_UART	125	0	C	5	0	3	0	2E8	8
16Z125_UART	125	0	C	B	0	4	0	220	8
16Z029_CAN	29	1	4	E	0	0	0	E100	100
16Z034_GPIO	34	0	6	E	0	0	0	E200	20
16Z034_GPIO	34	0	C	E	0	1	0	E220	20
16Z034_GPIO	34	0	C	E	0	2	0	E240	20
16Z037_GPIO	37	1	1	E	0	0	0	E260	20
16Z126_FLASH	126	0	4	3f	0	0	0	E280	20
16Z076_QSPI	76	0	5	E	0	0	0	E800	800
16Z024_SRAM	24	2	3	3f	0	0	0	F000	1000

5.1 GPIO Controller Instance 0

The default device name of the instance 0 of the GPIO controller 16z034- is "gpio_1". It is used to switch the functions given in [Table 18, Functions of GPIO controller instance 0](#).

Table 18. Functions of GPIO controller instance 0

Bit Position	Name	Function	Default Setting
0	gpio[0]	User LED A	IN
1	gpio[1]	Watchdog enable	IN
2	gpio[2]	SIMA_SW	IN
3	gpio[3]	SIMB_SW	IN
4	gpio[4]	mincard A PWR enable	IN

Bit Position	Name	Function	Default Setting
5	gpio[5]	mincard B PWR enable	IN
6	gpio[6]	User LED C	IN
7	gpio[7]	not used	IN

E.g. switching on the status LED:

```
z17_io -p=0 -s=0 gpio_1 -h
```

5.2 GPIO Controller Instance 2

The default device name of the instance 2 of the GPIO controller 16z034- is "gpio_3". It is used to change the serial interface 1 from UART (default setting) to SGPIO (SA15 Adapter).

Table 19. Functions of GPIO controller instance 0

Bit Position	Output-Function (GPO)	Input-Function (PSR)	Default Setting
6	mux_if0	-	GPO(6):drive 0

Interface Multiplexer (mux_if0)

Interface Multiplexer 0 truth table:

Interface	Function	mux_if0
SA0	UART0	0
	SGPIO	1

```
z17_io -p=6 -s=1 gpio_3
```

5.3 Activating the UART Interfaces

5.3.1 Linux

Table 20. Chameleon table

Name	Device	Variant	Revision	Interrupt	Group	Instance	BAR	Offset	Size
16Z125_UART	125	0	C	4	0	0	0	3F8	8
16Z125_UART	125	0	C	3	0	1	0	2F8	8
16Z125_UART	125	0	C	7	0	2	0	3E8	8
16Z125_UART	125	0	C	5	0	3	0	2E8	8
16Z125_UART	125	0	C	B	0	4	0	220	8

The UARTs controlling serial interface 2 (X3 ttyS0) and serial interface 1 (X4 ttyS1) are working without special settings as they are using the standard addresses and interrupts.

Custom-specific BC50M models may have additional UARTS available. To activate them use the following *setserial* commands:

- `setserial /dev/ttyS2 IRQ 7 uart 16550A`
- `setserial /dev/ttyS3 IRQ 5 uart 16550A`
- `setserial /dev/ttyS4 IRQ 11 port 0x220 uart 16550A`

6 Maintenance

6.1 Cleaning the System

The system should be cleaned once a year. Clean the bottom and top plate, remove dirt and dust from air ventilation holes. Light dirt can be removed with a dry cloth. Persistent dirt should only be removed with a mild detergent and a soft cloth.

Take care that no liquid gets inside the system.

7 Appendix



7.1 Literature and Web Resources

- BC50M data sheet with up-to-date information and documentation:
www.men.de/products/09BC50M.html

7.1.1 Accelerometer / Magnetometer LSM303DLM

Manufacturer's product page for LSM303DLM
STMicroelectronics

http://www.st.com/web/en/catalog/sense_power/FM89/SC1449

7.1.2 CAN bus

- CAN in Automation e. V.
www.can-cia.de

7.1.3 DVI

- Digital Visual Interface Revision 1.0
www.ddwg.org

7.1.4 Ethernet

- ANSI/IEEE 802.3-1996, Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications; 1996; IEEE
www.ieee.org
- Charles Spurgeon's Ethernet Web Site
Extensive information about Ethernet (IEEE 802.3) local area network (LAN) technology.
www.ethermanage.com/ethernet/
- InterOperability Laboratory, University of New Hampshire
This page covers general Ethernet technology.
www.iol.unh.edu/services/testing/ethernet/training/

7.1.5 HD Audio

- Intel High Definition Audio:
www.intel.com/design/chipsets/hdaudio.htm

7.1.6 PCI Express Mini Card

- PCI Express Mini Card Electromechanical Specification
Revision 1.2; October 26, 2007
PCI Special Interest Group
www.pcisig.com

7.1.7 USB

- USB Implementers Forum, Inc.
www.usb.org